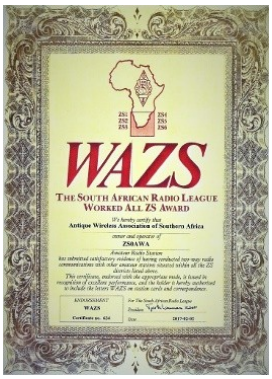
Antique Wireless Association of Southern Africa Newsletter

240 July 2026

National CRM

Uses a 1" 913 CRT for display. This line of National scopes were intended for use by radio operators, they were used to monitor modulation and have only minimal components as shown in schematic. Time base for horizontal sweep was derived from the AC power line at a 60 cycle rate or an from external signal. List price was $18.50 less tubes,



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Reflections:

One fine day in the middle of the night, two dead men got up to fight. Back to back they faced each other, drew their swords and shot one another…..If there are any of you that can remember many of those nonsense rhymes, then you're about as old as I am, maybe more.

I don't think that youngsters of today still learn all those silly rhymes any more, they are more concerned about Ai and gigabytes on their phones.

As a youngster, which seems a whole lifetime away now, I never read much. I could read and was very good at spelling and English language, but I did not have the time to read books.

I always wanted to be busy outside. Playing dinky cars on home made roads, riding bicycle, swimming which was almost an all year sport for us in Zambia. The swimming pools had a mandatory 3 month closure for maintenance and that was it.

During school holidays we would go out into the bush and go camping for a week. Just a bunch of youngsters with pellet guns.

We swam in quarries, caught fish to eat, ate wild berries and fruit and shot wild turkey which we braaied over a fire.

When I think of those things today, it almost sounds like it came out of an era of make believe or some novel written in the days of Davy Crocket.

My life existed for adventure and play. Swinging around in mango trees playing Tarzan, often falling out of them and breaking something.

At the tender age of thirteen I was sent off to boarding school in RSA to hopefully gain an education and learn some discipline. I think I learned a lot, but discipline was never one of my strong points.

I often wish that I had taken an interest in electronics, but it was not high on the agenda in those days. Instead music and photography became my high points in life.

The closest I ever came to radio was my little portable that I used to listen to LM radio every night, catching up on all the latest hits and the music of the 80's.

My introduction to radio communication came very much later in life after I had married and was living on the diamond mine in the Northern Cape.

CB radio caught my interest and soon I was setup to communicate with the world. This led to my getting involved in Signals in the Commando in the area and eventually introduced to Ham Radio by my signals officer.

I must apologise at this point for boring you with my biography, but my reason for it is that often I ask myself if I ever thought, after never maintaining an interest in something for a long period of time, that something like radio, would grab my attention for over forty years, and still be a driving force in my life.

I don't know what the history of many others was like, and whether there are any who had similar experiences, but this is what makes the world of amateur radio so interesting.

That people can come from all walks of life with so many different interests, to be like minded in one particular area. An area that would draw people to make friendships around the globe and open a world of communication that no one could ever dream of.

From CW to AM phone to SSB to RTTY to slow scan TV to Digital modes, they all come together to give us a communication mode that suits not only your lifestyle, but your life. I am sure there is not a radio operator that does not appreciate many of these modes and has used them all at least once in their lifetime as an operator.

Here's to Marconi and all those who followed him or superseded him to present us with a lifetime of memories.

Best 73

De Andy ZS6ADY

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ZS0AWA Net - Antique Amateur Radio Test Apparatus

Kevin Turner ZS6KAT

Introduction:

Today I'd like to take you on a nostalgic journey through the world of antique electronic test equipment used by radio amateurs—back when "test gear" meant something heavy enough to dent your bench, warm enough to heat your shack in winter, and expensive enough to make you think twice before turning it on.
But more than that, this is a story about how we measured the invisible world.
Because long before digital displays, before automatic calibration, and before everything became a button-press exercise, radio amateurs didn't just measure signals—they interpreted them.
And that theme runs through everything we'll look at today.

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1. The World Before Digital Everything

To understand antique test gear, we need to picture the radio amateur's shack from the 1930s through to the 1970s.
There were:

- no LCD screens
- no microcontrollers
- no spectrum displays

no automatic anything
If you wanted to know the frequency of an oscillator, you didn't navigate a menu—you built a circuit, probed it, and hoped your meter was telling the truth.
And calibration, of course, often meant comparing one slightly doubtful instrument against another slightly doubtful instrument and calling it "close enough."
That was normal.

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2. The Multi-meter – The AVO Legacy

We begin with the undisputed king of analogue test gear: the multi-meter.

In the UK, that meant the AvoMeter (AVO), later associated with Megger.
The AVO Model 7 and Model 8 became legendary.

- Introduced: 1930s onward
- Price in the 1960s: R400–R600

Equivalent today: roughly R7,000–R14,000
And remember—this was just a multi-meter.
It measured voltage, current and resistance… and occasionally your emotional resilience after you realised how much you had spent.
The AVO earned a reputation for being indestructible, which was fortunate, because dropping it on your foot could double as a medical emergency.
Inside was a beautifully engineered moving-coil mechanism — so precise that many engineers treated it with near-religious respect. If it failed, you didn't repair it casually. You approached it with tools, patience, and a sense of guilt.

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3. Then there was Measuring Resistance the Hard Way with The Wheatstone Bridge

Before moving coil ohmmeters, resistance was measured using the Wheatstone bridge.

- The concept was first developed by Samuel Hunter Christie in 1833.
- He described the circuit as a method for measuring unknown electrical resistance.
- Charles Wheatstone later popularised and refined the design in 1843 .

He made it widely known and practical for scientific use.
Early instruments used:

- tangent galvanometers, or

moving-magnet galvanometers
These typically had:

- a magnetic needle
- a coil of wire around it
- deflection based on magnetic torque

So the "null detector" in early bridges was mechanical and magnetic, but not the later d'Arsonval moving-coil design invented in 1882.
Later devices from companies like General Radio Company and other lab suppliers were common.

- Cost (1950s): R200–R500

Today: R5,000–R12,000 equivalent
In principle, it's elegant: you balance a bridge until a galvanometer reads zero.
In practice, it involves:

- twiddling knobs
- waiting for a needle to settle
- realising your hand has changed the result
- starting again.

We had a couple of reliable Marconi versions at Durban Radio, and I remember them quite well.
They were technically safe—but emotionally hazardous.
Because while they wouldn't shock you, they would very efficiently test your patience.

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4. Grid Dip Oscillators – The Ham's Favourite Guessing Game

Next comes one of the most iconic amateur tools: the grid dip oscillator, or GDO.

- The modern form of the grid dip oscillator is most commonly associated with Clarence R. Moore
He helped refine and popularise the device in the 1930s

☞ His design introduced:

- A vacuum tube oscillator

A meter that shows a "dip" when resonance is reached
Manufacturers included:

- Hewlett-Packard
- Millen
- Eico

Cost in the 1950s–60s:

- R300–R800

Equivalent today: R300–R900

The principle is simple: you couple the oscillator to a tuned circuit, and when resonance occurs, the current "dips."
Which is why it's called a dip meter.
Not because it's intuitive.
More because it reliably causes emotional dips in the operator.
As one amateur once said:
"It proves your coil does something—just not necessarily what you intended."

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5. Wavemeters – Frequency by Faith

Before frequency counters, amateurs used absorption wavemeters.
The absorption wavemeter was not invented by a single individual
It evolved from early radio research in the early 20th century.

It is based on resonance principles developed by pioneers like Heinrich Hertz, Oliver Lodge, and Guglielmo Marconi
I actually own one of these devices and posted a couple of photos of it on the AWA Telegram group earlier this morning.
These were tuneable devices that indicated resonance in circuits with a light bulb or a meter. The light in an absorption wavemeter is essentially a low-impedance indicator, which allows current to flow and produce visible brightness, but at the cost of loading the circuit and reducing measurement sharpness.
Operation was simple:

1. Couple it loosely to your transmitter
2. Adjust until maximum absorption
3. note the settings on the device and
4. read them off against a printed scale to determine the said wavelength or frequency.

Hope nobody nearby is more accurately on frequency than you are
Made by Marconi and other British manufacturers, they cost:

- R200–R500 at the time

R4,000–R10,000 equivalent today
Accuracy was best described as "enthusiastic."
But it worked well enough to keep most amateurs within band limits—most of the time.

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6. ESR Meters – The First Modern Relief

By the 1970s and 80s, solid-state electronics brought a quieter revolution: the ESR meter.
Used to test electrolytic capacitors in circuit, these devices from specialist suppliers cost:

- R400–R1,000 in the 1980s

R2,000–R5,000 equivalent today
For the first time, you didn't have to guess whether a capacitor was "a bit tired."
You could actually measure it.
It saved hours of fault-finding—and probably saved many perfectly good components from being thrown away simply because they looked suspicious.

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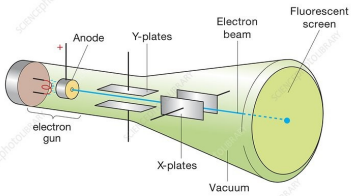
7. Oscilloscopes – The Window into the Invisible

No discussion of test gear is complete without oscilloscopes.



- The oscilloscope is widely credited to Karl Ferdinand Braun.

In **1897**, he developed the **cathode ray tube (CRT)**, which could display electrical signals visually
This device is often called the **Braun tube** and is the foundation of all early oscilloscopes.

Later engineers refined Braun's invention into practical oscilloscopes:

- Jonathan Zenneck
  - Applied CRTs to study waveforms
  - Vladimir Zworykin
  - Improved CRT technology

Companies like Tektronix (1940s onward) made oscilloscopes widely available and highly accurate.
Key manufacturers included:

- **Tektronix**
- Hewlett-Packard

Telequipment (UK)
A 1960s Tektronix scope cost:

- R4000–R10000

Equivalent today: R80000–R200,000
These were not hobby purchases. They were serious labora-

tory instruments that often had their own furniture.
And they were heavy enough that moving one required either a strong back—or a strong sense of regret.
Inside, you had:

- kilovolt CRT supplies
- hot valve circuitry

large capacitors that stayed charged long after switch-off
A common joke was:
"You didn't repair a scope—you negotiated with it."

8. Signal Generators – Making Signals You Could Trust (Mostly)
To test radios, you needed signals.
Signal generators from HP or Marconi were essential tools.

- Cost: R600–R3,000

Equivalent today: R12,000–R60,000+
The RF signal generator was not invented by a single individual
It evolved in the early 20th century from radio oscillator technology
Key contributors include Edwin Armstrong and Lee De Forest, while companies like Hewlett-Packard and General Radio made it a practical instrument

In short: It's an evolutionary invention built on vacuum tube oscillator technology rather than a single breakthrough moment.
They provided controlled RF signals for alignment and testing.
Without them, you were essentially tuning by ear and optimism.
And many amateurs still did exactly that.
But there were quirks:

- unintended RF radiation
- harmonics everywhere
- occasional RF burns
- signals leaking into nearby receivers whether you wanted them or not

At times, your signal generator was less a precision instrument and more a very small, poorly controlled transmitter.

9. The Hidden Danger – Live Chassis Equipment
Now we come to something more serious: safety.
Many early instruments used **live chassis designs**, meaning:

- no isolation transformer
- chassis connected directly to mains

plug polarity determined whether the case was "safe-ish" or not

This affected:

- signal tracers
- service meters
- early alignment tools

Technicians sometimes discovered this the hard way when touching:

- probe grounds
- metal cases
- bench frames

Modern engineers would politely describe this as:
"aggressively non-compliant with modern safety expectations."

10. Valve Testers – Judgement Machines with High Voltage

No discussion is complete without valve testers.
A **valve tester** was not invented by a single widely credited individual
It **emerged in the 1920s–1930s** as vacuum tubes became widely used
Early development was driven by engineers and companies such as:

- Hickok Electrical Instrument Company
- Weston Electrical Instrument Corporation
- General Electric
- Avo Meter

These instruments tested:

- emission
- shorts
- grid leakage
- mutual conductance

But they required:

- manual setup from complex charts
- dozens of switch settings
- careful valve insertion into multi-socket panels

And they often ran at **hundreds of volts**, with exposed contacts.
So the real danger wasn't just electrical—it was psychological.
Because a valve might test:

- "GOOD" today
- "WEAK" tomorrow
- "MARGINAL" depending on its mood

They gave opinions.

11. What Has Replaced All This?
Today, we've replaced entire benches of equipment with:

- digital multimeters

- SDRs
- antenna analysers
- USB oscilloscopes
- software-based spectrum tools

What once filled a workshop now fits in a coat pocket.

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12. Were These Instruments Affordable?
Let's be honest—mostly, no.
A typical 1960s setup:

- AVO meter: R500
- Signal generator: R1,000
- Oscilloscope: R6,000
- Grid dip meter: R600

Total: R8,000–R12,000 in 1960s money
Today: roughly R160,000–R240,000

So most amateurs:

- built their own equipment
- borrowed from clubs or workplaces
- or simply made do

And that constraint drove enormous creativity.

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13. Conclusion – What We've Gained and Lost
So what do we take from all this?
We've gained:

- accuracy
- portability
- automation

affordability
But we've lost something too.
Older test equipment forced you to slow down. To interpret. To think. A needle didn't just give you a number—it told a story.
A dip wasn't just a reading—it was something you had to understand.
Modern instruments give answers instantly. Old instruments made you earn them.
And perhaps that's why many of us still find them so fascinating.
Because they didn't just measure the invisible world—They made us part of the measurement.

After Class: The Wheatstone Bridge
February 1959 Popular Electronics

The Wheatstone bridge is a fundamental electronic circuit invented by Charles Wheatstone in 1843, renowned for its exceptional precision in measuring unknown electrical resistances. Its basic configuration consists of four resistors arranged in a diamond pattern with a voltage source and a zero-center galvanometer. When the bridge is "balanced" and the galvanometer reads zero, the ratio of the resistances is equal, allowing the value of an unknown resistor (Rx) to be calculated using the formula Rx = R2 × (R3/R4). This *Popular Electronics* magazine article explains how to construct a simple, accurate bridge using a slide wire for R3 and R4, where their ratio is determined by the lengths of the wire. By selecting a known resistor for R2 and adjusting the slide until balance is achieved, one can precisely calculate Rx. Beyond resistance, the principle is widely adapted for measuring capacitance, inductance, and in various control and testing applications, making it one of electronics' most versatile circuits.

By Harvey Pollack

Aside from the simple series and parallel circuits, the Wheatstone bridge arrangement probably appears in more electronic applications than any other circuit. Invented in 1843 by the English scientist, Charles Wheatstone, the original bridge has been modified countless times to make it suitable for thousands of different uses in control circuits, testing, and radio and television.

Just what is a Wheatstone bridge? What principles are involved in its operation? What is it used for?

Operating Principle

The fundamental bridge circuit is given in Fig. 1. The arrangement comprises R_x and R_2 in series, R_3 and R_4 in series, with the two series groups in parallel with each other across the voltage source. A zero-center galvanometer (M_1) is connected to junctions B and D.

By correctly selecting the four resistance values, it is possible to make the galvanometer read zero regardless of the voltage of the battery (B1). When the galvanometer reads zero, the voltage across points B and D must also be zero. There is only one way that this can happen:

(a) The voltage drop across R_x (from A to B) must equal the voltage drop across R_3 (from A to D). Designating the current in the upper series branch (A-B-C) as I_1 and the current in the lower series branch (A-D-C) as I_2, we can write: $I_1 \times R_x = I_2 \times R_3$ since a voltage drop is always the product of the current times the resistance.

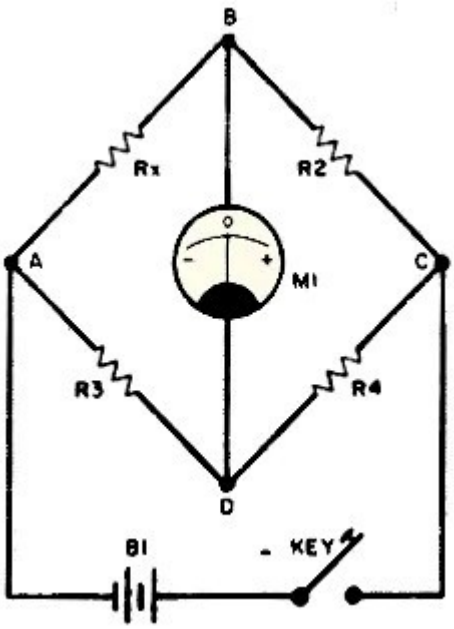


Fig. 1 - Basic Wheatstone bridge circuit from which all the other bridge circuits are derived.

(b) Since the voltage across both branches must be equal to the battery potential applied across A-C, then from condition (a) we know that the drop across R_2 must equal the drop across R_4. The current in R_2 is I_1 since R_2 and R_x are in series. Similarly, the current in R_4 is I_2. Thus:

$I_1 \times R_2 = I_2 \times R_4$

(c) If the first equation is divided by the second, all the currents cancel out and we are left with the simple relation:

$R_x/R_2 = R_3/R_4$

If we now multiply both sides of this last equation by R2, we arrive at the final form:

$R_x = R_2 \times (R_3/R_4)$

What this final equation really says is that the value of an unknown resistance Rx may be obtained if the other three resistances are known. Using the correct value of Rx, the bridge can be "balanced," that is, the galvanometer will show no deflection. Measurement of resistances on the Wheatstone bridge can be extremely accurate - much more so than by VOM or VTVM.

Building Your Own Bridge

An amazingly precise Wheatstone bridge can be constructed in an hour or two from some inexpensive materials and any zero-centered sensitive meter. (Many of the surplus mail order houses can supply inexpensive microammeters of this type.) The construction details are illustrated in Fig. 2.

A slide wire consisting of about three feet of #28 nichrome or similar material taken from an old wire-wound rheostat forms R_3 and R_4. A test probe can be slid along the Nichrome wire so that R_3 measured from A to D is varied as R_4 (D to C) is simultaneously changed in the opposite sense.

The actual resistance of R_3 and R_4 need not be known. Since resistance of a uniform wire varies directly as the length, the ratio of the length AD to the length DC as read on the yardstick or meter stick is the same as R_3/R_4. Hence, all you have to know accurately is the resistance of R_2.

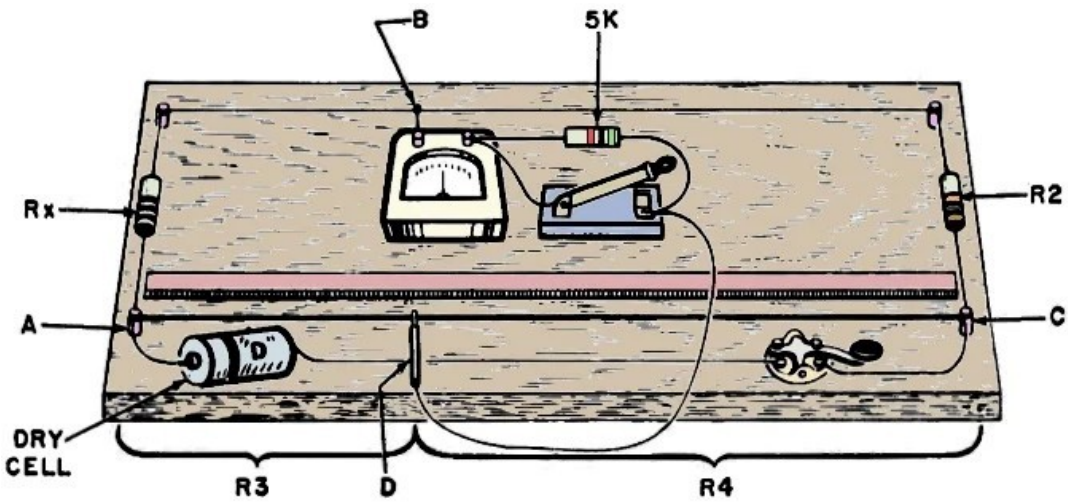
Precision resistor decade box of the type used to provide a resistance standard (Eico 1171).

You might build up a supply of 1% resistors of different values for substitution across the R2 binding posts, or if you own a resistance decade box, this can be used.

Using the Bridge

Suppose you want to find the resistance of an unknown resistor with good precision. If you know the approximate range of resistance that you're dealing with, choose a value for R_2 of about the same range. If you have no idea of the value of Rx, use a hit-or-miss system.

Touch the test prod to the slide wire near the center and, making sure that the protective resistor switch is open, tap the key while you watch the meter. The deflection will



probably be large. Now slide the prod along the wire in the direction that causes the deflection to decrease. If you have to go to either end of the slide wire before reaching zero, R_2 has been incorrectly selected - try another value.

When you finally obtain a zero reading with the test prod at least 3" away from an end of the wire, close the knife switch (this short-circuits the protective resistor) and again tap the key. The instrument will now be very sensitive, so inch your way along the wire until you again obtain zero deflection. Note the length AD (R_3) and DC (R_4) on the yardstick; then merely substitute in the last equation and solve for the value of Rx.

For example, let's say that an unknown resistor of about 10,000 ohms is to be measured. R_2 is chosen as 10,000 ohms (1%) and the slide-wire bridge manipulated until the galvanometer shows balance. Length AD turns out to be 46.4 centimeters on the meter stick. Hence, length DC must be 53.6 cm. since one meter contains 100 cm. Thus:

$R_x = R_2 \times R_3/R_4$

$R_x = 10{,}000 \times 46.4/53.6$

$R_x = 8660$ ohms ± 1%

The Wheatstone bridge principle is not limited to simple resistance measurements. In modified form, it can be used for determining unknown capacitances and inductances, for measuring gain of electron tubes (in the form of a Miller bridge), detection of leakage in insulation, and many other important applications.

Antique Wireless Association of Southern Africa

CONTAT US:

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Mission Statement

Our aim is to facilitate, generate and maintain an interest in the location, acquisition, repair and use of yesterdays radio's and associated equipment. To encourage all like minded amateurs to do the same thus ensuring the maintenance and preservation of our amateur heritage.

Membership of this group is free and by association. Join by logging in to our website.

Notices:

Net Times and Frequencies (SAST):
Saturday 07:00 (05:00 UTC) —Western Cape SSB Net —7.140; Every afternoon during the week from 17:00
Saturday 08:30 (06:30 UTC)— National SSB Net— 7.125
Echolink—ZS0AWA-L;
ZS6STN Sandton repeater—145.700
Kempton Park Repeater—145.6625
Relay on 10.125 and 14.135 (Try all and see what suits you)

Saturday 14:00 (12:00 UTC)— CW Net—7.025

AWASA Telegram group:

Should you want to get on the AWA Telegram group where a lot of technical discussion takes place, send a message to Andy ZS6ADY asking to be placed on the group. This is a no-Nonsense group, only for AWA business. You must download the Telegram App first. …..+27824484368